EP 410,088 B1

Description

The invention concerns a welding or plasma cutting device consisting of an a.c.-powered rectifier that supplies power to an intermediate circuit which in turn supplies power to a current transformer at the primary end that is operated in alternation, where electronic switches driven by a control unit are provided for switching the current transformer, and consisting of at least one, preferably two current paths that carry current in alternation and are provided on the secondary side of the current transformer, where the paths are connected to the consumer via an inductance, and the device also contains a rectifier diode.

A device of the type defined initially is known from U.S. Patent 4,564,742, where greater control is achieved by alternately driving the pair of current transformers with pulses that do not overlap within a period, because one of the two current transformers is always operated in the current pause of the other due to the fact that they are triggered in alternation. Thus the entire period is available for operation at maximum power. To control the pair of current transformers, controllable semiconductor switches are used with the known device. With regard to their dielectric strength, these [semiconductor switches] must have a certain reserve due to the comparatively great tolerance in the voltage of the a.c. or three-phase network.

On the other hand, the fluctuations in network voltage and therefore the fluctuations in the d.c. voltage in the intermediate circuit have a negative effect on the machining process to which the device supplies power.

Therefore, the object of the present invention is to minimize the effects of fluctuations in line voltage on the welding or plasma cutting process.

This object is achieved according to this invention by the fact that the rectifier is provided with switches controlled by a voltage device such that the intermediate circuit voltage level can be set at a predetermined setpoint by the ON time of the switches.

The stabilization circuit provided according to this invention for the intermediate circuit voltage can be implemented by a comparatively simple electronic control circuit. The d.c.

voltage applied to the intermediate circuit is measured as the actual value for the voltage control circuit and is regulated at an externally defined setpoint. The d.c. voltage applied at the output of the control circuit thus completely levels out fluctuations in line voltage. Therefore, the semiconductor switches for controlling the pair of current transformers at the primary end need no longer be overdimensioned to accommodate the highest possible line voltage. In addition, the quality of the machining operation can be improved significantly because the voltage available for the process at the output of the device according to this invention is adequately stable.

According to a first preferred embodiment of the invention, the controllable switches are arranged in parallel with the rectifier such that it is connected to the common connection terminal of a series connection consisting of another inductance and a diode and arranged upstream from the intermediate circuit. In this variant of the stabilization circuit, the particular advantage is that the stabilized d.c. voltage available at the intermediate circuit is equal to or greater than the d.c. voltage that is delivered at the output of the rectifier but is subject to the fluctuations in line voltage. This variant is thus suitable for types of operation where the intermediate circuit voltage should be greater than 500 V, for example.

In another variant of the invention, the controllable switch is arranged in a series circuit with another inductance which is in turn connected in series with the rectifier, where a diode in parallel with the rectifier is connected at the common connection terminal of the switch and inductance. With this stabilizing circuit, the intermediate circuit receives a stabilized d.c. voltage which is lower than the fluctuating d.c. voltage delivered by the rectifier. Thus, for example, a current transformer designed for a low voltage can be supplied with a higher line voltage accordingly in a reliable manner.

A third variant of this invention provides for a controllable switch to be connected in parallel with the rectifier diodes of the rectifier.

It is also possible to influence the d.c. voltage at the output of the rectifier through the clock time of the respective switch within the rectifier bridge without requiring additional electronic devices.

Additional preferred embodiments are characterized in

Subclaims 4 and 5.

The invention is explained in greater detail below on the basis of the figures which illustrate three embodiments.

Figure 1 shows a first embodiment of the invention.

Figure 2 shows a second embodiment of the invention.

Figure 3 shows a third embodiment of the invention.

Figure 1 shows a rectifier 2 that receives power from a three-phase network 1 and drives a capacitor that forms the intermediate circuit which in turn supplies an inverter connected downstream from it. The inverter consists of two separate current transformers 18, 19 that are driven via semiconductor switches 4, 5, 6, 7 that are cycled by a control device 8 such that non-overlapping currents flow alternately into current transformer 18, 19 at the input end. The free-wheeling diodes in the primary circuit cause demagnetization of the current transformers 18, 19 during the intervals when the transformers 18, 19 are not being cycled by their semiconductor switches 4, 5 and 6, 7.

The secondary sides of the current transformers 18, 19 have two connections, each of which forms a lead wire for a circuit, and a common central connection terminal for the current return line. Each of the two circuits has a rectifier diode 9, 10 to rectify the voltage induced in the secondary winding of the current transformers 18, 19.

The two secondary tapping points are joined at a common point, and from there they are connected via an inductance 17 to a terminal 16 of the welding electrode whose other terminal 15 is connected to the center tapping point. A free-wheeling diode 22 is arranged parallel to welding electrode 15, 16 in the secondary circuit. To measure the current flowing into welding electrode 15, 16, a measurement device 21 is provided, while the other measurement device 20 detects the voltage applied to welding electrode 15, 16. Both measurement devices 21, 22 act on control device 8, thus forming a feedback control circuit.

The circuitry described so far is illustrated in Figures 1 to 3. However, Figures 1 to 3 differ in the circuit upstream from intermediate circuit 3, by means of which the d.c. voltage applied to intermediate circuit 3 is stabilized to eliminate voltage fluctuations in a.c. system 1.

In the first variant of the stabilizing system according to this invention as illustrated in Figure 1, a series connection

consisting of another inductance 13 and a diode 14 is located between rectifier 2 and intermediate circuit 3.

At the common connection terminal of the additional inductance 13 and diode 14, a semiconductor 12 is connected in parallel with rectifier 2 and intermediate circuit 3 and is driven by a voltage control device 11 that receives input signals from a voltage measurement device 11a and a setpoint generator. Measurement device 11a measures the d.c. voltage applied to intermediate circuit 3. The clock frequency of switch 12 is controlled by the circuit described here such that the d.c. voltage on intermediate circuit 3 corresponds to the d.c. voltage set by the setpoint generator. It is characteristic of this circuit that the stabilized d.c. voltage applied to the intermediate circuit is always higher than the unstabilized d.c. voltage delivered by rectifier 2. [illegible] higher

In the second embodiment of the invention illustrated in Figure 2, the controlled semiconductor switch 12 is connected in series with the additional inductance 13 in the connecting branch between rectifier 2 and intermediate circuit 3. Diode 14 is connected in parallel with rectifier 2 and intermediate circuit 3 and is connected to the common connection terminal of semiconductor switch 12 and the additional inductance 13. Semiconductor switch 12 is also controlled via the measurement device 11a for the intermediate circuit voltage and controller 11. This circuit is suitable for applications where the required stabilized intermediate circuit voltage should be lower than the unstabilized voltage delivered by rectifier 2. By varying the clock frequency of switch 12, the d.c. voltage delivered at the output of the control circuit can be made to approximate the setpoint. lower

The third alternative illustrated in Figure 3 shows that semiconductor switches 12a-12f which are controlled by controller 11 are connected in parallel with the six rectifier diodes that are usually provided in rectifier 2. Semiconductor switches 12a-12f are operated in pairs so that the d.c. voltage smoothed by the additional inductance at the output of the rectifier corresponds to the desired setpoint. This also avoids an excessive increase or reduction in the d.c. voltage delivered due to fluctuations in the line voltage.

Claims

1. Welding or plasma cutting device consisting of an AC powered rectifier (2) feeding into an intermediate circuit (3) to power a current transformer (18,19) alternately pulsed on the primary side, whereby the pulsing of the current transformer (18,19) is accomplished by selectable electronic switches (4,5,6,7) commanded by a controller (8), and of a minimum of one, but more particularly two alternately conducting current paths, each provided with an integral rectifying diode (9,10), on the secondary side of the current transformer (18,19) and which are connected to the user (15,16) through an inductance (17), characterized in that selectable switches (12,12a,12b,12c,12d,12e, 12f) are associated with the rectifier (2) such that the switch on time of the switches (12,12a,12b, 12c,12d,12e,12f) may be sequenced by a voltage controller (11) to set the voltage level of the intermediate circuit to a given command value.

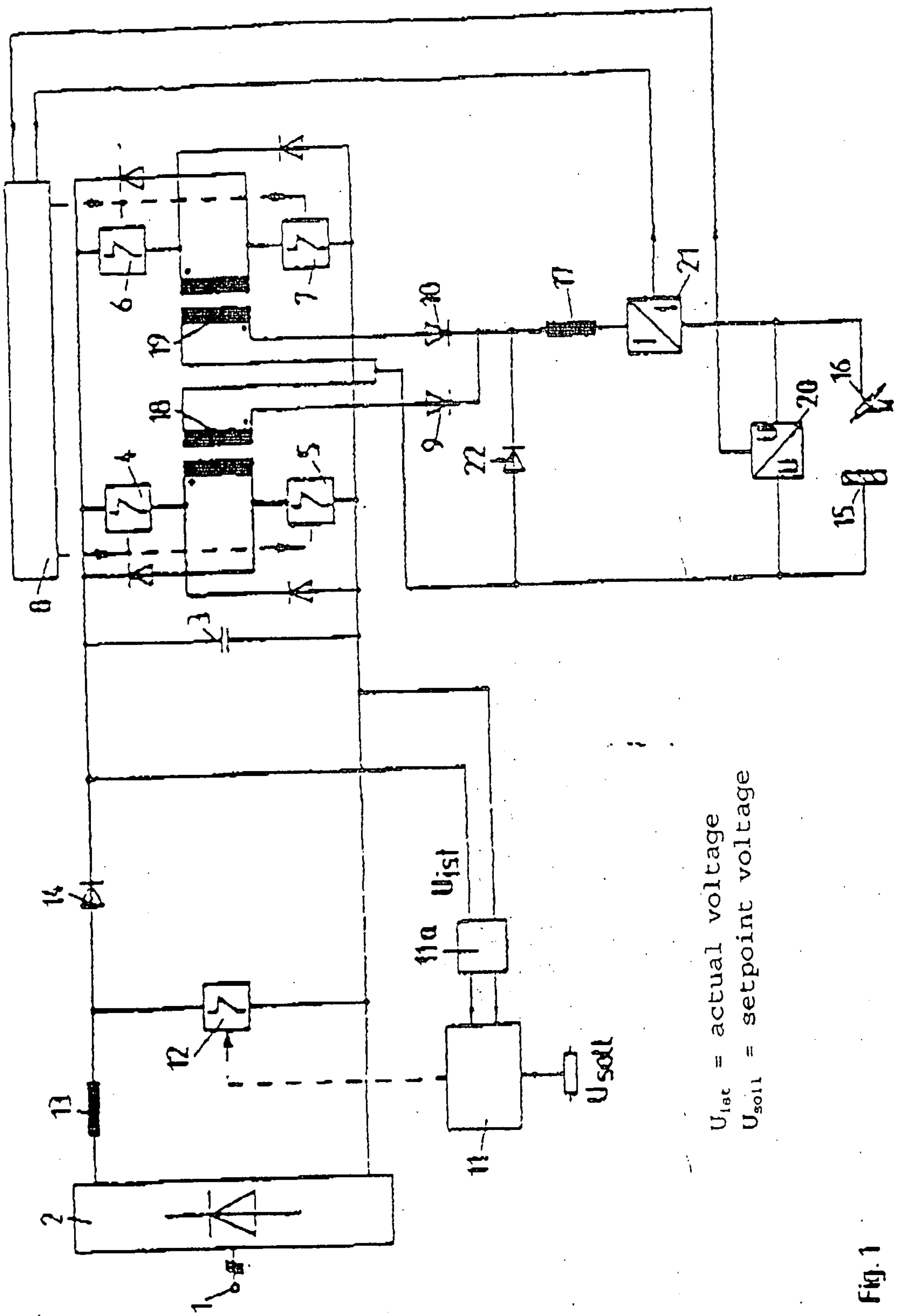
2. Welding or plasma cutting device according to Claim 1, characterized in that the selectable switch (12) is connected in parallel to the rectifier (2) at a common connection terminal of a series circuit comprising a further inductance (13) and a diode (14), arranged prior to the intermediate circuit (3).

3. Welding or plasma cutting device according to Claim 1, characterized in that the selectable switch (12) is connected in series between the rectifier (2) and the further inductance (13) whereby a diode (14) is connected in parallel to the rectifier (2) at the common terminal between the switch (12) and the reactor (13).

4. Welding or plasma cutting device according to Claim 1, characterized in that the rectifying diodes of the rectifier (2) each have a selectable switch (12a-12f) connected in parallel.

5. Welding or plasma cutting device according to Claim 1 through 4, characterized in that the selectable switches (12,12a-12f) are bipolar transistors.

6. Welding or plasma cutting device according to Claim 1 through 5, characterized in that the selectable switches are IGBTs.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U_ist = actual voltage
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Fig. 1

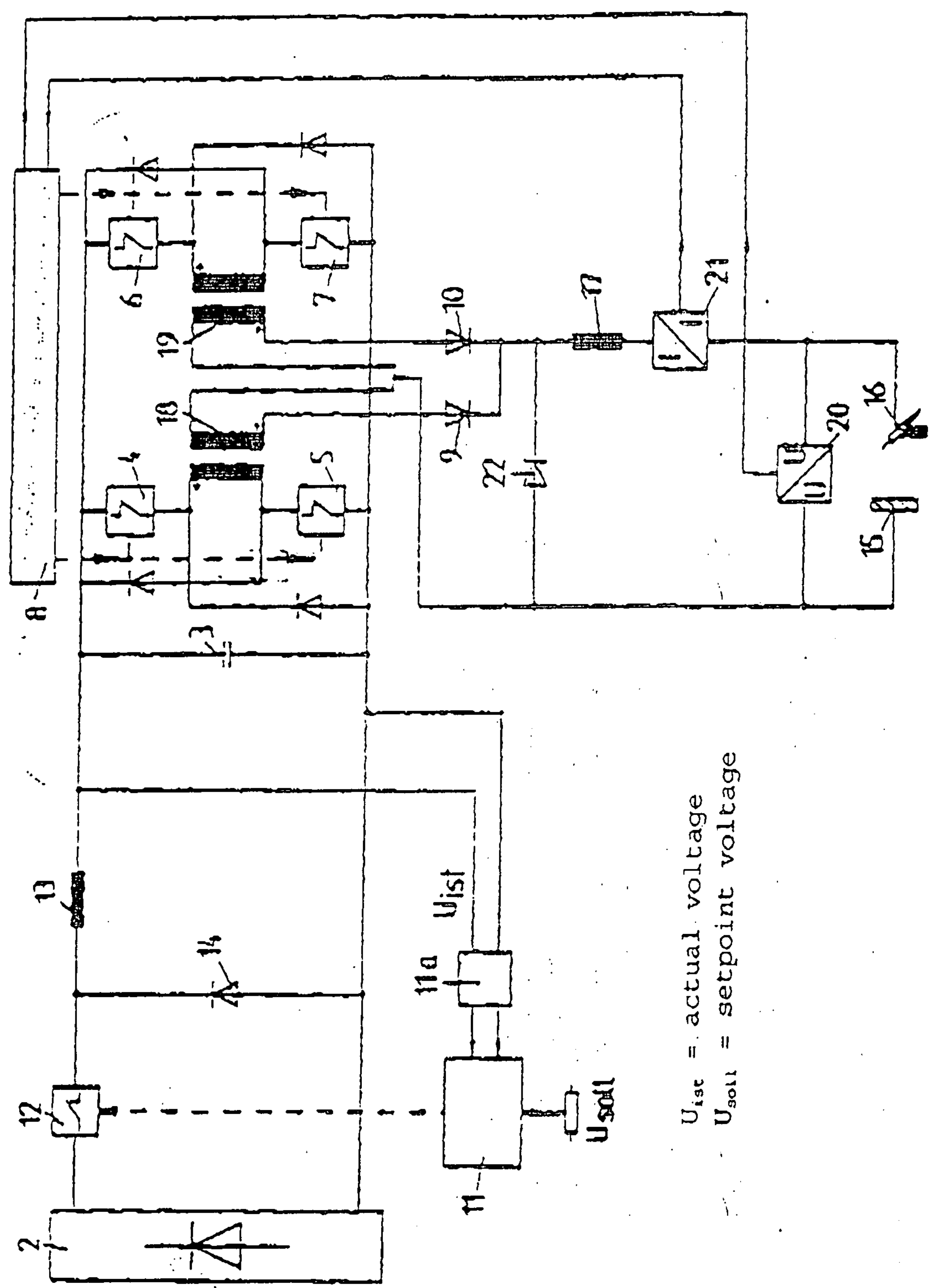

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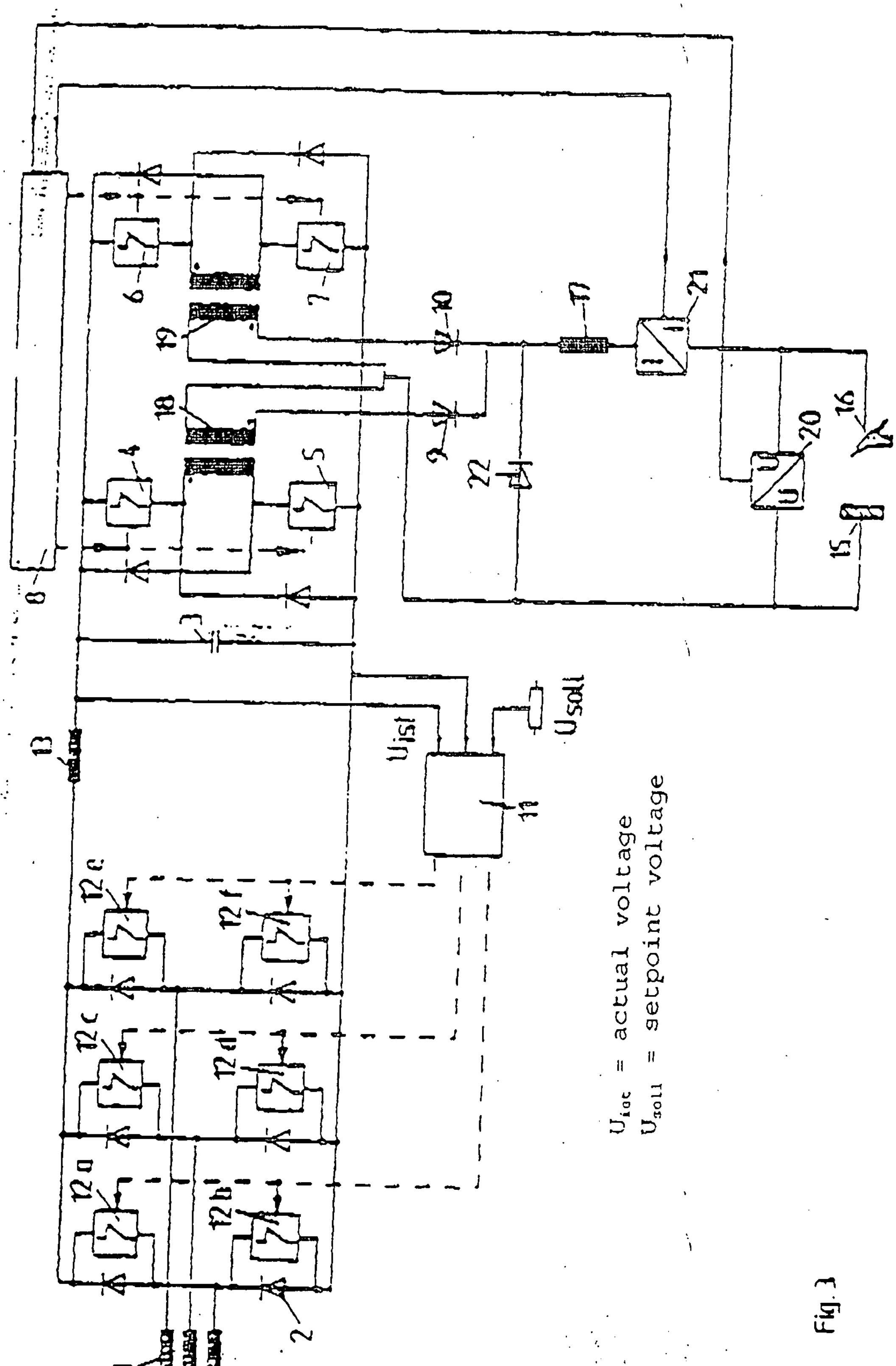
Fig. 2



U_{ist} = actual voltage
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Fig. 3